



**Mathematical Formulae****1. ALGEBRA***Quadratic Equation*

For the equation  $ax^2 + bx + c = 0$ ,

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} .$$

*Binomial Theorem*

$$(a + b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \dots + \binom{n}{r} a^{n-r} b^r + \dots + b^n,$$

where  $n$  is a positive integer and  $\binom{n}{r} = \frac{n!}{(n-r)!r!}$ .

**2. TRIGONOMETRY***Identities*

$$\sin^2 A + \cos^2 A = 1.$$

$$\sec^2 A = 1 + \tan^2 A.$$

$$\operatorname{cosec}^2 A = 1 + \cot^2 A.$$

*Formulae for  $\Delta ABC$* 

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C} .$$

$$a^2 = b^2 + c^2 - 2bc \cos A.$$

$$\Delta = \frac{1}{2} bc \sin A.$$

1 A function  $f$  is defined by  $f: x \mapsto e^{x-1}$ , where  $x > 0$ .

(i) State the range of  $f$ . [1]

(ii) Find an expression for  $f^{-1}$ . [2]

(iii) State the domain of  $f^{-1}$ . [1]

2 (i) Find the first four terms, in ascending powers of  $x$ , in the expansion of  $\left(2 - \frac{x}{2}\right)^6$ . [4]

(ii) Find the coefficient of  $x^3$  in the expansion of  $(1+x)^2 \left(2 - \frac{x}{2}\right)^6$ . [2]

3 The table shows experimental values of the variables  $x$  and  $y$  which are related by the equation

$$y = \frac{a}{x^2} + \frac{b}{x}, \text{ where } a \text{ and } b \text{ are constants.}$$

$x$	2	4	6	8	10
$y$	6.24	2.82	1.79	1.33	1.05

(i) Using graph paper, plot  $x^2y$  against  $x$  and draw a straight line graph. [3]

(ii) Use your graph to estimate the value of  $a$  and of  $b$ . [4]

4 Find the coordinates and the nature of the stationary points of the curve  $y = x^3 + 3x^2 - 45x + 60$ . [7]

5 Relative to an origin  $O$ , the position vectors of points  $A$  and  $B$  are  $\begin{pmatrix} 7 \\ 24 \end{pmatrix}$  and  $\begin{pmatrix} 10 \\ 20 \end{pmatrix}$  respectively. Find

(i) the length of  $\overrightarrow{OA}$ , [2]

(ii) the length of  $\overrightarrow{AB}$ . [2]

Given that  $ABC$  is a straight line and that the length of  $\overrightarrow{AC}$  is equal to the length of  $\overrightarrow{OA}$ , find

(iii) the position vector of the point  $C$ . [3]

6 (i) Given that  $y = x\sqrt{4x+12}$ , show that  $\frac{dy}{dx} = \frac{k(x+2)}{\sqrt{4x+12}}$ , where  $k$  is a constant to be found. [4]

(ii) Hence evaluate  $\int_{-2}^6 \frac{3x+6}{\sqrt{4x+12}} dx$ . [3]

- 7 (i) Using graph paper, draw the curve  $y = \sin 2x$  for  $0^\circ \leq x \leq 360^\circ$ . [3]
- In order to solve the equation  $1 + \sin 2x = 2\cos x$  another curve must be added to your diagram.
- (ii) Write down the equation of this curve and add this curve to your diagram. [3]
- (iii) State the number of values of  $x$  which satisfy the equation  $1 + \sin 2x = 2\cos x$  for  $0^\circ \leq x \leq 360^\circ$ . [1]

8 It is given that  $\mathbf{A} = \begin{pmatrix} 2 & -1 \\ 4 & 3 \end{pmatrix}$ ,  $\mathbf{B} = \begin{pmatrix} 1 & -3 \\ 2 & 0 \end{pmatrix}$  and  $\mathbf{C} = \begin{pmatrix} 5 \\ -2 \end{pmatrix}$ . Find

(i)  $\mathbf{AB}$ , [2]

(ii)  $\mathbf{BC}$ , [2]

(iii)  $\mathbf{A}^{-1}$ , and hence find the matrix  $\mathbf{X}$  such that  $\mathbf{AX} = \mathbf{B}$ . [4]

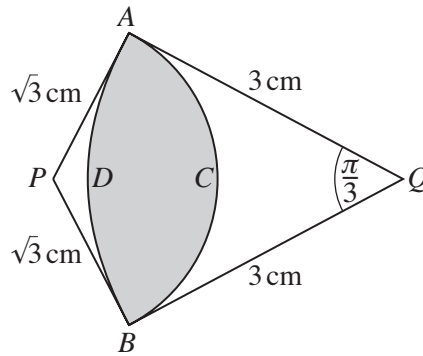
- 9 A particle moves in a straight line so that,  $t$  seconds after passing through a fixed point  $O$ , its velocity,  $v \text{ ms}^{-1}$ , is given by  $v = \frac{20}{(2t + 4)^2}$ . Find
- (i) the velocity of the particle at  $O$ , [1]
- (ii) the acceleration of the particle when  $t = 3$ , [3]
- (iii) the distance travelled by the particle in the first 8 seconds. [4]

10 (a) Solve  $\lg(7x - 3) + 2 \lg 5 = 2 + \lg(x + 3)$ . [4]

(b) Use the substitution  $u = 3^x$  to solve the equation  $3^{x+1} + 3^{2-x} = 28$ . [5]

11 Answer only **one** of the following two alternatives.

**EITHER**

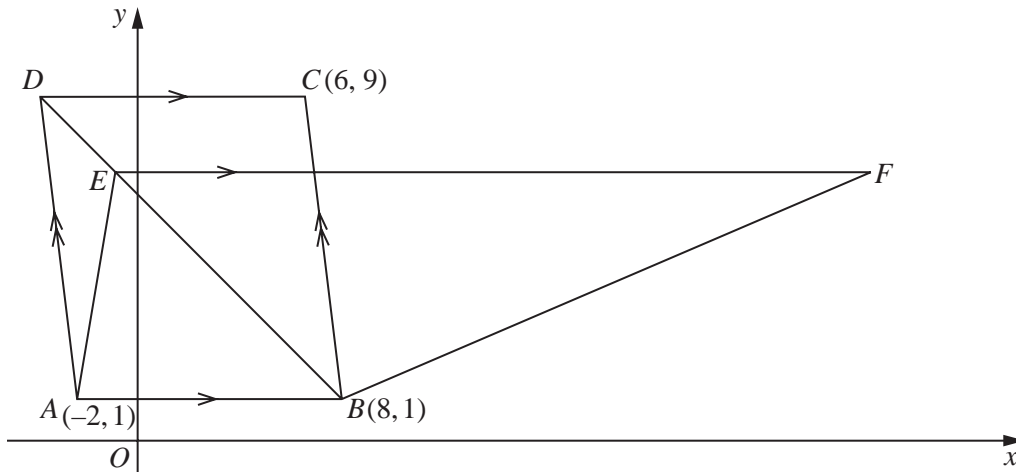


In the diagram,  $ACB$  is an arc of a circle with centre  $P$ , and  $ADB$  is an arc of a circle with centre  $Q$ . Angle  $AQB = \frac{\pi}{3}$ ,  $AQ = BQ = 3$  cm and  $AP = BP = \sqrt{3}$  cm.

- (i) Show that angle  $APB = \frac{2\pi}{3}$ . [2]
- (ii) Find the perimeter of the shaded region. [3]
- (iii) Find the area of the shaded region. [5]

**OR**

**Solutions to this question by accurate drawing will not be accepted.**



The diagram shows a parallelogram with vertices  $A(-2, 1)$ ,  $B(8, 1)$ ,  $C(6, 9)$  and  $D$ .

- (i) Find the coordinates of  $D$ . [2]

The point  $E$  lies on the diagonal  $DB$  such that  $DE = \frac{1}{4}DB$ .

- (ii) Find the coordinates of  $E$ . [2]

The point  $F$  is such that  $EF$  is parallel to  $AB$ .

The area of trapezium  $AEFB$  is  $1\frac{1}{2} \times$  (the area of parallelogram  $ABCD$ ).

- (iii) Find the coordinates of  $F$ . [6]





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